PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

High Efficiency Engines and Turbines

12/2002

CORRELATION OF IGNITION DELAY WITH FUEL COMPOSITION FOR APPLICATION TO GAS AND LIQUID FIRED LEAN BURN GAS TURBINE COMBUSTORS

PRIMARY PROJECT PARTNER

University of California, Irvine

COST

$ 135,936

CUSTOMER SERVICE

800-553-7681

STRATEGIC CENTER FOR NATURAL GAS WEBSITE

www.netl.doe.gov/scng

Description

This Advanced Gas Turbine Systems Research (AGTSR) project builds on the success of an earlier AGTSR project that developed and utilized i) a combustor with flexible geometry, ii) a premixer designed to control inlet mixedness and turbulent properties, iii) fuel blending apparatus to allow for delivery of a wide a variety of fuel compositions, and iv) experience in operation with a variety of fuels. This combustor and associated apparatus will be used in the current project to verify autoignition correlation relationships determined from data using an ignition delay test section.

Task 1 of the current project modifies a flame holding test facility for ignition delay measurements. Task 2 and 3 conduct gaseous fuel ignition delay experiments in the first year, liquid fuel ignition delay experiments in the second year, and analyze the data. The analysis will yield an empirical expression that describes ignition delay time as a function of fuel composition, inlet air temperature, inlet air pressure, flow velocity, and free stream turbulence. Task 4 verifies the empirical expression for ignition time delay using the fuel flexible combustor from the previous AGTSR project operated over a range of conditions.

The project will involve interactions with six gas turbine related organizations, General Electric, Parker Hannifin, Rolls-Royce, Siemens Westinghouse, Solar Turbines, and UTRC/Pratt&Whitney.

Duration

24 months

Correlation of Ignition Delay with Fuel Composition for Application to Gas and Liquid Fired Lean Burn Gas Turbine Combustors

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Goals

Uniform mixing of fuel and air at fuel lean conditions in a premixer before combustion is critical to producing low emissions from gas turbine combustors. Fuel-air residence times in the premixer must be sufficiently long for thorough mixing needed to inhibit NO_X formation but not so long as to result in premature autoignition or damaging flashback into the premixer chambers. Consequently, the knowledge of autoignition characteristics as a function of operating parameters is needed for the design of fuel flexible, low NO_X combustors. The goal of this project is to measure global activation energies that enable determination of autoignition delay times as a function of combustor operating parameters such as fuel composition, inlet temperatures and pressures, turbulence intensities, and fuel concentrations.

Benefits

This project will provide data for combustor design rules to avoid autoignition in lean premixed turbine combustion systems.

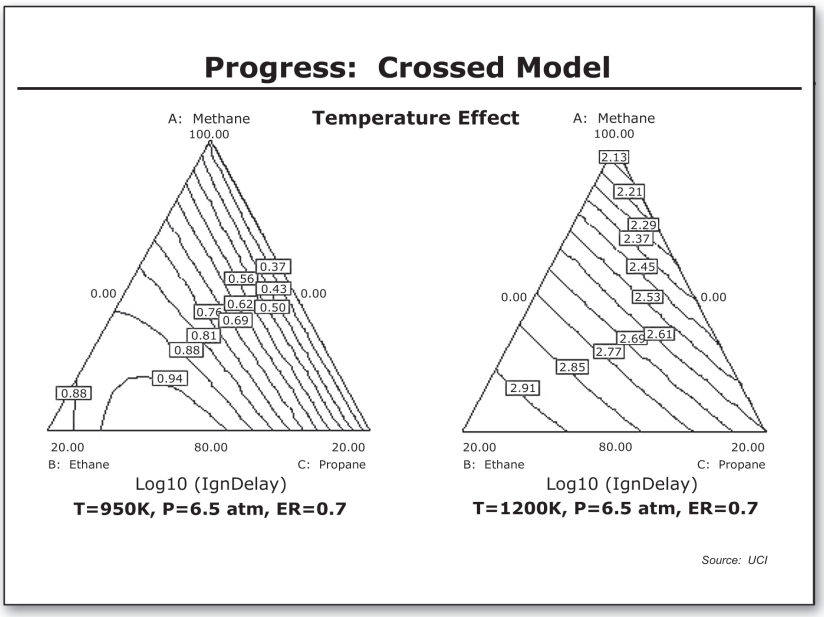

Figure 1. Ignition Delay Versus Temperature and Fuel Composition